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ABSTRACT

Extant literature lacks established frameworks or methods that can be used to evaluate a supply chain strategy. In this paper we present a type-independent approach to evaluate a business unit's supply chain strategy as a conceptual system. Using as its starting point a conceptualization of the supply chain strategy known as a functional strategy map, the approach calls for an evaluation of the supply chain strategy along seven general evaluation criteria: feasibility, support, coverage, compatibility, sufficiency, synergy, and parsimony. For some of these evaluation criteria, we have proposed an evaluation method. Both the proposed criteria and methods were tested and refined through two action research projects. The ability of the approach to identify conflicts in the supply chain strategy provides evidence in support of its evaluative power. As more replications are conducted, our understanding of the capabilities and limitations of both the criteria and the method are bound to improve. At this point, nevertheless, the method and criteria have shown enough promise to warrant further exploration and refinement, and represent a novel contribution to the literature.

1. INTRODUCTION

Over a quarter of a century ago, Shapiro and Heskett (1985) described what was back then called *logistics management* as “characterized by a difficult, yet fundamental dichotomy” between a tactical, detailed, quantitative and short-term orientation on the one hand and a strategic, broad, qualitative and long-term orientation on the other. Shapiro and Heskett called

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these two perspectives “the two faces of logistics” and – while they recognized that both were required “at one and the same time” – they also asserted that “logistics’ most important role is strategic”, due to its potential “to advance a company’s strategic goals.” The discipline, known today as *supply chain management*, has developed greatly in the intervening decades. Yet its development has not been uniform: whereas operational areas have seen multiple and important breakthroughs, little progress has been made on the strategic areas of supply chain management.

As a result, extant supply chain management literature fails to answer fundamental questions about supply chain strategy (SCS), as illustrated by the following challenge:

Suppose one is given reasonably comprehensive descriptions of a business unit, its business strategy, its supply chain and its environment; suppose one is also given a supply chain strategy for consideration. What are the legitimate grounds for evaluating this supply chain strategy and to what theories, knowledge or models can one turn for help in making such an evaluation?

The original version of this “idealized problem” was posed by Rumelt (1979) as a preamble to his work on the evaluation of strategy in organizations. Rumelt’s problem, reworded here in terms of supply chain strategy, the challenge presents us with basic questions for which the current literature has no established answers.

Mirroring this gap in the theory is a blind spot in the mindset of many supply chain managers, who are often unaware of supply chain strategy evaluation as a possibility, let alone a necessity. Even as they seek to enhance, update or rethink the supply chain strategy of their business units, many managers do not have in mind conducting first a formal evaluation of the supply chain strategy they currently have in place. An anecdote, drawn from our experience, illustrates this point: out of nine companies that have approached MIT’s CTL in recent years with an interest in enhancing their supply chain strategy (see Table 1), only one sought from the start to conduct an *evaluation* of their existing supply chain strategy (#8 in the table).

Interestingly, when presented with the idea of conducting a formal evaluation of their current supply chain strategy, most of these managers were quick to embrace the concept. This suggests their initial omission may have been not one of principle, but one of oversight.

Example #1: a global business unit from a	Example #2: a company in the health care	Example #3: a business unit from a
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company in the specialty chemicals industry. Facing growing competition from low cost providers in China and increasing costs of raw materials, the VP of supply chain decided it was time to rethink their unit's supply chain strategy.	industry, competing in both drugs and devices, recently developed a new business strategy. They expressed interest in finding whether their current supply chain strategy continues to be adequate, and if not, how it should be adjusted for a better fit.	company in the electronics industry, dedicated to computers. Having recently acquired a leading position in certain key markets, the business unit has expressed interest in ensuring they have the right supply chain strategy in place to stay ahead.
Example #4: a U.S. company in the food industry. Facing the challenges of the 'great recession,' the CEO asked its VP of supply chain to update their supply chain strategy, to be both more efficient and better prepared for the challenges of the future.	Example #5: a business unit from a company in the health care industry, dedicated to distribution. New regulations on the industry required a change of their competitive model. This prompted the head of their business unit's supply chain to rethink their supply chain strategy.	Example #6: a company in the health care industry, specializing in high tech medical devices. Facing challenges brought by fast growth, they hired a new CEO, who launched a significantly different business strategy and asked that the supply chain strategy be rethought to better align with it.
Example #7: a global corporation in the chemical industry. Perceiving its leadership position was threatened by supply-chain savvy competitors, it decides to develop a global supply chain strategy at the corporate level, and to enhance the existing supply chain strategies at the business unit level.	Example #8: a U.S. utility company, with a large proprietary fleet. After multiple supply chain initiatives at the operational level, the attention has moved to the strategic level. They have manifested interest in evaluating the company's current supply chain strategy, to identify areas for improvement.	Example #9: a company in the food industry, with global operations. In recent years, many of their key suppliers have been acquired by a new corporation. The company is interested in examining the implication of this supplier consolidation on their supply chain strategy.

Table 1: Examples of business units interested in rethinking their supply chain strategy

On the subject of supply chain strategy evaluation, one can speculate about the existence – and direction – of a link between the underdevelopment of theory and the lack of awareness on its importance among practitioners. In any case, the discipline of supply chain management can only benefit from the development, in collaboration with practitioners, of stronger theory on the strategy front. Inadequate attention to theory building has been blamed for slowing the progress of supply chain management as a discipline (Ho, Au, & Newton, 2002). Recent years have seen reassessments of the extant theory (Choi & Wacker, 2011) and frequent calls for more theory development in supply chain management (Carter, 2011). Contributions to the literature on research methods for theory building in supply chain management have multiplied (Salvador, 2011; Skilton, 2011), including lessons from related disciplines such as organizational sciences (Ketchen & Hult, 2011; Rindova, 2011) and strategic management (Hitt, 2011). It is towards this common goal of theory generation for the advancement of supply chain management – particularly in the more neglected areas in supply chain strategy – that we outline in the present working paper an approach to evaluate a supply chain strategy, developed over the last seven years through collaborative management research projects of the Supply Chain 2020 Project.

2. LITERATURE REVIEW

Although the supply chain management literature provides no direct answer to the question of how to evaluate a supply chain strategy, it does contain ideas – some with more, some with

less empirical support – about what makes for a good supply chain strategy. These ideas are often provided through what we call *type-match* approaches. Below we discuss the most salient.

Fisher's pioneer type-match framework

Fisher (1997) presented a framework to help managers devise an effective supply chain strategy². As support for this framework, Fisher offers some anecdotal evidence from his experience during “ten years of research and consulting in supply chain.” Below we present a summary of Fisher's approach, in terms of three tasks that we consider basic: first, how it goes about *characterizing*³ a given supply chain strategy; second, what *criteria* it proposes for evaluating that supply chain strategy; and third, what *mechanism* – if any – is proposed to apply these evaluation criteria in order to evaluate the supply chain strategy.

Characterization. Fisher's framework characterizes a supply chain strategy as the combination of two elements: a product demand type and a supply chain type. The framework classifies these elements into two types each: products, based on their demand patterns, are classified as “either primarily functional or primarily innovative;” whereas supply chains, based on their priorities, are classified as either “physically efficient or responsive to the market.” By arranging the supply chain types vertically and the product types horizontally, Fisher generated a now famous 2-by-2 matrix, in which four combinations of the elements' types are possible. As we will see below, some combinations are to be preferred, while others are to be avoided.

Criteria. The underlying logic of the framework is Fisher's claim that good performance depends on the right ‘match’ between types of the two elements, namely on the right match of product types and supply chain types. According to Fisher, not all four type-match combinations are desirable. The merit of the type matches is judged according to the following prescription: a functional product requires an efficient supply chain process, we are told, whereas an innovative product requires a responsive supply chain process. When the “right” supply chain type is used for a given product type, there is a “match,” conducive to better “performance”; when it is not, there is a “mismatch”, conducive to “problems”. These matches and mismatches are indicated in

² Fisher (1997) and other contemporary publications seem to use the terms ‘*supply chain*’ and ‘*supply chain strategy*’ almost as synonyms. This is excused given the nascent state of supply chain strategy as an area of study.

³ That is to say, how it describes the character or quality of a supply chain strategy.

the four cells of Fisher's 2-by-2 matrix. The *type-match* logic in Fisher's framework boils down to the following: out of the four possible supply chain strategies described in the 2-by-2 matrix, only two are deemed conducive to good performance. Later we explore the validity of this claim.

Mechanism. For managers who want to apply Fisher's framework, he suggests a three-step mechanism. Step 1 is to consider the nature of the demand for the product and classify the product as either primarily functional or primarily innovative. Step 2 is for the manager to decide whether the priority of supply chain in question is to be physically efficient or responsive to the market. Step 3 is for the manager to "discover" whether the supply chain "is well matched to the product type," in terms of logic outlined in Fisher's 2-by-2 matrix.

Subsequent type-match frameworks

The impact of Fisher's (1997) article cannot be overstated. The type-match framework it presents is easy to grasp and intuitively appealing. To this day Fisher (1997) remains one of the most widely cited articles in the supply chain management literature, and by far the most influential on the subject of supply chain strategy. After its publication, other similar type-match frameworks followed, including revisions and expansions to Fisher's ideas (see Table 2).

In what is probably the most prominent expansion of Fisher's (1997) framework, Lee (2002) included the *supply* side and reframed demand patterns in terms of *uncertainties*. Lee's underlying logic is that "demand and supply uncertainties can be used as a framework to devise the right supply chain strategy". He introduces four types of supply chains: efficient supply chain, risk-hedging supply chain, responsive supply chain, and agile supply chain. For each of the four possible combination of high or low uncertainty in both demand and supply, Lee then prescribes matches with one of the four supply chain types. Lee (2002)'s type-matches are summarized in the second row of Table 2.

Another "evolution of the original framework" proposed by Fisher (1997) is presented by Cigolini, Cozzi and Perona (2004). While adjusting the names of Fisher's two original types of supply chains, they added a third type: 'lean.' They also rethought the types of products in terms of life cycle phase and their inherent structural complexity, to produce four product types: stable demand, growing demand, complex, and ephemeral demand. From these four product types and three supply chain types, they prepared a 4-by-3 matrix, in which they prescribe desirable matches between supply chain types and product types, summarized in the third row of Table 2.

General Information	Element Types	Strategy Matches
(Fisher, 1997) Supply chain types: 2 Prescribed matches: 2	<ul style="list-style-type: none"> Product (2 types, by demand pattern): <ul style="list-style-type: none"> Primarily functional Primarily innovative Supply chain (2 types): <ul style="list-style-type: none"> Physically efficient supply chain Market responsive supply chain 	<ul style="list-style-type: none"> Physically efficient supply chain + Primarily functional product Market responsive supply chain + Primarily innovative product
(Lee, 2002) Supply chain types: 4 Prescribed matches: 4	<ul style="list-style-type: none"> Demand uncertainty: <ul style="list-style-type: none"> Low (Functional products) High (Innovative products) Supply uncertainty: <ul style="list-style-type: none"> Low (Stable process) High (Evolving process) Supply chain (4 types): <ul style="list-style-type: none"> Efficient supply chain Risk-hedging supply chain Responsive supply chain Agile supply chain 	<ul style="list-style-type: none"> Low demand uncertainty + Low supply uncertainty + Efficient supply chain High demand uncertainty + Low supply uncertainty + Responsive supply chain Low demand uncertainty + High supply uncertainty + Risk-hedging supply chain High demand uncertainty + High supply uncertainty + Agile supply chain
(Cigolini et al., 2004) Supply chain types: 3 Prescribed matches: 4	<ul style="list-style-type: none"> Product (4 types, by demand pattern): <ul style="list-style-type: none"> Stable demand Growing demand Complex product Ephemeral demand Supply chain (3 types): <ul style="list-style-type: none"> Efficient supply chain Lean supply chain Quick supply chain 	<ul style="list-style-type: none"> Stable demand product + Efficient supply chain Growing demand product + Lean supply chain Complex product + Lean supply chain Ephemeral demand product + Quick supply chain
(Narasimhan et al., 2008) Supply chain types: 3 Prescribed matches: 3	<ul style="list-style-type: none"> Stage (3 types): <ul style="list-style-type: none"> Early stage Expansion stage Mature stage Supply chain (3 types): <ul style="list-style-type: none"> Variability focused Bridge (market-share focused) Velocity focused 	<ul style="list-style-type: none"> Early stage + Variability focused supply chain Expansion stage + Bridge (market-share focused) supply chain Mature stage + Velocity focused supply chain

Table 2: Summary of some prominent type-match approaches

A third example is found in Narasimhan, Kim, & Tan (2008). They propose three strategy types, which can be loosely described as variability-focused strategy, velocity-focused strategy, and a bridge (or market-share focused) strategy. The claim is then made that these supply chain types are a good match for three corresponding “stages” of a supply chain: early, expansion and mature (see the fourth row in Table 2). We will return to Narasimhan, *et al.* with a critical eye.

Criticism of Fisher’s type-match framework

Since the three type-match approaches described are built, overtly or implicitly, upon Fisher’s (1997) ideas that a given type of a supply chain should be matched with a given type of something else, we focus our criticism on the source of this ideas: Fisher’s (1997) seminal type-match framework, which – along with its 2-by-2 matrix – “has been widely accepted by researchers,” yet “has not been tested in a broad empirical manner” (Qi & Boyer, 2009). Recent efforts to empirically validate Fisher’s framework and claims (such as Li & O'Brien, 2001; Lo &

Power, 2010; Qi & Boyer, 2009; and Selldin & Olhager, 2007) have produced mixed and inconclusive results at best, offering little validation to some of Fisher's (1997) claims, while negating others altogether. Below we summarize these validation efforts, grouped by theme.

On the existence of match between types

Li & O'Brien (2001) used a multiple objective optimization model of the selection of manufacturing strategies to analyze the relationship between product types and supply chain strategies. Their results provide evidence in favor of the matching of a responsive process with innovative products, but against the matching of an efficient process and functional products.

Qi & Boyer (2009) conducted "one of the first large-scale empirical studies to investigate supply chain strategies and examine the relationship between product characteristics and supply chain strategy". Based on statistical analysis of data about Chinese manufacturers obtained through a survey with 604 useable responses, they found significant evidence for the matching of innovative products and responsive supply chains, but not for the matching of functional products with efficient supply chains.

Lo & Power (2010) conducted a survey of managers in the manufacturing industry in Australia. With 107 useable responses, their findings "indicate that the association between product nature and supply chain strategy is not significant."

Selldin & Olhager (2007) found earlier a similar insight: results from their survey of Swedish manufacturing companies, including 128 responses, indicate "there is not an overall clear match between product type and supply chain design; the regression line is non-significant."

Here a caveat is pertinent. Even if all these studies had found solid evidence that type matching was taking place in the field – which they didn't – this on its own would provide no support to Fisher's *prescriptive* claim that certain type matches lead to better performance, unless and until additional evidence was found suggesting that those matches prescribed by Fisher led to (or at a minimum were associated with) better performance.

On the effect of match on performance

Since the findings discussed above refer to what firms are doing (e.g. whether matching is taking place), and not to what results are obtained (e.g. whether matching is desirable), Selldin & Olhager (2007) analyzed the four combinations of product and supply chain types from Fisher's

matrix with respect to performance, measured in terms of cost, flexibility and profitability, among others. Among multiple hypotheses they tested, three directly address key predictions from Fisher's framework: (a) that companies with a 'match' of product type and supply chain type have higher profitability than companies with a 'mismatch', (b) that companies matching functional products with efficient supply chains perform better on cost, and (c) that companies matching innovative products with responsive supply chains perform better on delivery speed and flexibility. Selldin & Olhager found that none of these three key hypotheses is supported by the data. Of particular interest is their finding regarding the financial performance hypothesis, about which they say: "A match between product and supply chain would assumingly, according to theory, lead to better financial performance. However, we could not find any significant differences for the direct effect of matching products and supply chains."

On the validity of types

Discussing the findings of their survey, mentioned above, Lo & Power (2010) argue that Fisher's separation of products into two "exclusive" types "appears to be problematic," since "the analysis results indicate that out of 107 respondents, 23 and 0 identified themselves as providing pure functional and innovative products respectively," while the remaining 84 respondents (78%) "identified themselves as providing products with a mixture of functional and innovative characteristics as defined by Fisher." Lo & Power (2010) also highlight the conflict between Fisher's "typology" of supply chain strategy, where efficient and responsive supply chain strategies "are treated as being mutually exclusive," and the findings of their survey, where "most surveyed companies (74 out of 107 [69%]) pursue both efficiency and responsiveness as their supply chain strategy." Lo & Power conclude that a "hybrid strategy combining both efficiency and responsiveness" may possibly be found in real business circumstances.

Unbeknownst to Lo & Power (2010), further evidence in support of their conclusion was obtained earlier in a study by Qi & Boyer (2009), which found that manufacturers in China can be classified into four strategic groups, which – to use Fisher's terminology – we could call efficient, responsive, neither efficient nor responsive, and both efficient and responsive; and that this last type, which combines both efficient and responsive features, outperforms – both financially and in terms of customer service – both the efficient and the responsive ones.

On the validity of the model

After the results of their study suggested Fisher's model is "questionable," Lo & Power (2010) proposed several reasons to explain why it is "not supported" by empirical data. Besides the problematic classification of both products and strategies into two distinct and exclusive types each, Lo & Power argue that "there appears to be more factors [that need to be] considered as the determinants of supply chain strategy".

A similar thought is expressed by Li & O'Brien (2001) when they remark that no "typical supply chain strategy performs the best all the time", speculating that the "operational environment significantly influences their roles."

It has been said that "models necessarily simplify things and reduce the dimensions of the world" (Derman, 2011). In the case of Fisher's model of supply chain strategy, the evidence – or lack thereof – from the above mentioned studies suggest his simplification of products and supply chains into a few types, combined with his reduction of the problem to only these elements, left out of the picture more important and decisive factors.

The elusive pursuit of supply chain strategy types

As we have seen, Fisher (1997) proposed *two* types of supply chain strategy. Cigolini, Cozzi and Perona (2004) expanded the list to *three*, and Lee (2002) took it further to *four* types. Frohlich & Westbrook (2001) claim "at least *five* valid types" of supply chain strategy, based on an empirical study of integration. Martinez-Olvera & Shunk (2006) suggested *six* types. This brings up the question: How many types of supply chain strategy are there? One could argue that, even though Fisher's types may have been overly simplistic, better results might be obtained through an empirical study focused on identifying types or groups of supply chain strategies. As it turns out, several recent studies have been conducted with this goal in mind.

One such study is reported in McKone-Sweet & Lee (2009): through the analysis of a large database of companies, the authors identified a taxonomy of supply chain strategies. The resulting taxonomy had three⁴ groups: one with high level of organizational capabilities, one with high level of information technology (IT) capabilities, and one with high levels of both.

⁴ It is worth noting that McKone-Sweet & Lee had predetermined the number of groups at three beforehand, since a "three-cluster model best satisfied" a series of methodological criteria related to the use of cluster analysis, their chosen tool for data analysis.

Another study along similar lines is Narasimhan, Kim, & Tan (2008), which we have mentioned above. Their study seeks to “create and describe a typology” of supply chain strategies, based on results from a survey with 411 useable responses. Narasimhan, *et al.*, is remarkable, however, in the lengths to which the authors went in order to reduce the initial number of types to just a few types holding a striking resemblance to the Fisher types. An earlier examination of the data yielded 14 supply chain strategy types for consideration. These were narrowed down – more or less arbitrarily – to only six supply chain types. These six types, despite being deemed “meaningful and interpretable” and with a “robust theoretical basis,” were nevertheless further shoe-horned without much ceremony to only three⁵ types. These three strategy types, which can be loosely described as variability-focused strategy, velocity-focused strategy, and a bridge (a market-share focused) strategy, were then matched – without much empirical support to justify the matching – with three “stages” of the supply chain: early, expansion and mature, in a type-match approach reminiscent of the one presented in Aitken, Childerhouse and Towill (2003).

Despite the theoretical difference⁶ between a taxonomy and a typology, one could have reasonably expected relatively similar results from the two studies mentioned above, since they were both conducted with empirical data, and both used a target of three clusters of supply chain strategies grouped by their characteristics. However, remarkably, the three supply chain strategies identified by Narasimhan, Kim, & Tan (2008) are entirely different from the three identified by McKone-Sweet & Lee (2009). They bear no resemblance to each other whatsoever.

In summary, using the existing literature as a reference, the answer to “*How many types of supply chain strategy are there?*” seems to be “*more than one but less than fifteen.*” Even if we were to agree that the number is “*about three*” it remains unclear which three are we to consider. Such a state of affairs casts doubts upon the usefulness of continuing to address the question of supply chain strategy evaluation through type-match approaches.

A lesson from the study of personality

Current understanding of supply chain strategy, heavily reliant on types, seems to be as

⁵ Narasimhan, *et al.* thought three was “the appropriate number of clusters;” they, too, used cluster analysis.

⁶ A taxonomy, as opposed to a typology, seeks to find classes, not types; classes need not be mutually exclusive.

mature as the understanding of human personality was when Eysenck & Himmelweit (1947) proposed – based on factor analysis research – that human temperament was characterized by two factors, neuroticism and extraversion, which when paired produced results similar to Galen’s four types of human temperament.

A widely used personality test first published in 1967, the Myers-Briggs Type Indicator (MBTI) describes psychological types by means of four factors, with two types each, for a total of sixteen different combinations. Updated versions of the MBTI are often used today as a *predictor of performance* for the purpose of hiring and promotion in firms; yet the test has been criticized for assuming that something as complex as personality can be described in simplistic “either-or” types, and for not accounting for the dynamic and often inconsistent nature of personality (Gladwell, 2006).

Recent advances in personality assessment include techniques to describe a personality in a more complete and nuanced way, based on data collected from longer questioning, interaction or even from the observation of a person in action, which could serve as better predictors of performance (Gladwell, 2006).

Supply chain management, as a discipline, may be well advised to learn from psychology’s travails in assessing personality, and move from the traditionally rigid, over-simplistic type-based frameworks towards new ones that, while firmly grounded on the supply chain’s activities, allow for a richer and more nuanced assessment of a firm’s supply chain strategy. Because, despite what most of the current literature on supply chain strategy seems to assume, the question facing practitioners in their daily life is not “*What type of supply chain strategy do I have?*” but “*Do I have a good supply chain strategy?*” The real question is evaluation, not typification. To put it in Rumelt’s terms: “*Given a supply chain strategy, what are the legitimate grounds and models we can use for evaluating it?*” The existing literature has no answer for this question.

3. THE FSE FRAMEWORK

The purpose of this paper is to propose a type-independent approach for the evaluation of the supply chain strategy of a business unit. We will refer to it as the Functional Strategy Evaluation (FSE) Framework. The present section introduces the elements of the framework, namely its approach supply chain strategy characterization, its evaluation criteria and suggested method for

conducting the evaluation. Section 4 presents a summary of how the framework was developed, while Section 5 illustrates the framework with examples taken from real projects.

SCS Characterization

To characterize the supply chain strategy of a business unit before evaluation, the framework presented in this paper makes use of the Functional Strategy Mapping Method (FSM Method), proposed by Perez-Franco, Caplice, Singh and Sheffi (2011). Its output, called a Functional Strategy Map (FSM), is a graphical representation of a business unit's supply chain strategy as a conceptual system, that is to say, as a group of interrelated concepts working together to accomplish a common purpose. The FSM makes explicit the role of a supply chain strategy as a bridge between a business unit's strategy and its supply chain's operations.

Building upon the idea that – in general – strategy is revealed by activities (Andrews, 1971; Porter, 1996) and – in particular – that supply chain strategy is revealed by supply chain activities (Cigolini et al., 2004), the FSM Method seeks to tap into the tacit knowledge (Baumard, 1999; Harrison, 1987; Tsoukas, 2005) managers have about their business unit's supply chain activities in order to *reveal* its supply chain strategy, and then *capture* it as a conceptual system. The FSM provides a *type-independent* characterization of a supply chain strategy, since it relies on no typology of supply chain strategies.

A prerequisite to the evaluation process discussed below is the construction of a FSM for the supply chain strategy to be evaluated, following the protocol described in Perez-Franco, *et al.* (2011). The working model of supply chain strategy underlying the FSM makes use of five categories of concepts, or *layers*, spanning from the strategic to the operational (Figure 1).

The two extreme layers, called 'Strategic Cores' and 'Supporting Means,' are not relevant to our evaluation framework, since the concepts they contain are, respectively, too strategic or too operational for the question at hand. Only the three middle layers are used in the evaluation. These three layers are: the Strategic Pillars (SPs), which articulate the business unit's strategic imperatives for the supply chain, including imperatives derived from the business strategy and the business environment; the Functional Principles (FPs), which state the most pressing guiding principles driving the functions related to the supply chain; and the Operational Practices (OPs), which are general statements about how supply chain and related operations are conducted in the business unit. An example of an FSM, as is used for evaluation, is shown in Figure 4.

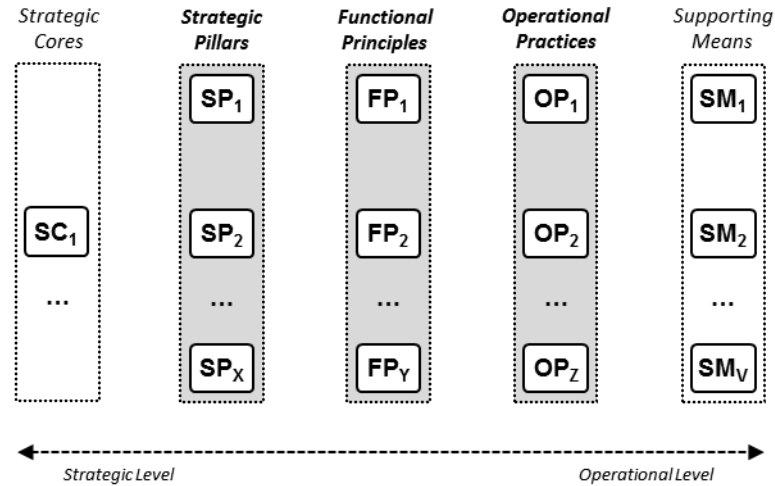


Figure 1: Supply chain strategy model underlying the FSM (abridged)

Evaluation Criteria

After asking “what criteria can and should be used in evaluating the strategy” of an organization, Rumelt (1979) recasts “the evaluation problem in terms of the negative logic of hypothesis testing”, asking instead “on what grounds may a proposed strategy be ‘refuted’ or rejected?” He then states several discernible “evaluation criteria that are context free – that are always valid.” In that same spirit, but focused on the evaluation of the supply chain strategy of a business unit, our framework proposes the use of seven general evaluation criteria that should apply independent of the context of a supply chain strategy, that – to put it in Rumelt’s terms – should be “always valid”.

When these seven general criteria are applied at the different layers of the supply chain strategy model (Figure 1), they can be expressed as fifteen specific evaluation criteria. A description of both the general and the specific evaluation criteria is presented below, and a graphical representation is offered in Figure 2. Examples of the application of these criteria for the evaluation of actual supply chain strategy concepts are provided later in Section 5.

- **General Criteria 1: Support.** Each concept in a given layer of the model is expected to provide support to at least one concept in the layer immediately above it.
 - *Specific Criteria 1a: Functional Support.* Each Functional Principle (FP) is expected to provide support to at least one Strategic Pillar (SP).
 - *Specific Criteria 1b: Operational Support.* Each Operational Practice (OP) is

expected to provide support to at least one FP.

- **General Criteria 2: Compatibility.** Each concept from a given layer of the model is expected to be compatible with each of the other concepts in that layer. Compatible here is understood as “capable of existing together in harmony” (cf. M-W.com)
 - *Specific Criteria 2a: Strategic Compatibility.* Each SP is expected to be compatible with each of the other SPs.
 - *Specific Criteria 2b: Functional Compatibility.* Each FP is expected to be compatible with each of the other FPs.
 - *Specific Criteria 2c: Operational Compatibility.* Each OP is expected to be compatible with each of the other OPs.
- **General Criteria 3: Feasibility.** It is expected that each concept from a higher layer is feasible by means of concepts in the layer immediately under it. Feasible is understood here as “capable of being done or carried out” (cf. M-W.com).
 - *Specific Criteria 3a: Strategic Feasibility.* Each SP, considered as a goal, should be feasible by means of FPs.
 - *Specific Criteria 3b: Functional Feasibility.* Each FP, considered as a goal, should be feasible by means of OPs.
- **General Criteria 4: Coverage.** No area of interest at the level of a conceptual layer should be left unaddressed by the collection of concepts in that layer.
 - *Specific Criteria 4a: Strategic Coverage.* No area of interest at the strategic level should be left unaddressed by the collection of SPs.
 - *Specific Criteria 4b: Functional Coverage.* No area of interest at the functional level should be left unaddressed by the collection of FPs.
 - *Specific Criteria 4c: Operational Coverage.* No area of interest at the operational level should be left unaddressed by the collection of OPs.
- **General Criteria 5: Sufficiency.** Each concept from a higher layer, considered as a goal, should be satisfied as much as possible by the aggregate support it receives from the concepts in the layer immediately under it.
 - *Specific Criteria 5a: Strategic Sufficiency.* Each SP, considered as a goal, should be satisfied as much as possible by the aggregate support it receives from the FPs.
 - *Specific Criteria 5b: Functional Sufficiency.* Each FP, considered as a goal, should be

satisfied as much as possible by the aggregate support it receives from the OPs.

- **General Criteria 6: Synergy.** It is desirable for a concept from a given layer of the model to have synergy with other concepts in that layer. Synergy here is understood as a “mutually advantageous conjunction” (M-W.com).
 - *Specific Criteria 6a: Strategic Synergy.* It is desirable for a SP to have synergies, and to not have ‘negative synergy,’ with other SPs.
 - *Specific Criteria 6b: Functional Synergy.* It is desirable for a FP to have synergies with other FPs.
 - *Specific Criteria 6c: Operational Synergy.* It is desirable for an OP to have synergies with other OPs.

In each of these instances, having no synergy at all is acceptable. On the other hand, having what we call ‘anti-synergy’, e.g. a mutually disadvantageous conjunctions, is not desirable. In our experience, most trade-offs are characterized by the presence of these ‘anti-synergy’ between concepts within a conceptual layer. Examples are given in Section 5.

Horizontal vs vertical. The six general evaluation criteria can be grouped by the direction of the relationship they are assessing: horizontal relationships between concepts are assessed by the compatibility, coverage and synergy criteria, whereas vertical relationships between concepts are assessed by the support, feasibility and sufficiency criteria.

- **General Criteria 7: Parsimony.** It is expected that each concept from a lower layer, in providing support to the concepts above it, do so in the most parsimonious way, e.g. being careful and economical in the use of means and resources applied to achieving its end.
 - *Specific Criteria 7a: Functional Parsimony.* Each FP, considered as a means, should be parsimonious in its support of SPs.
 - *Specific Criteria 7b: Operational Parsimony.* Each OP, considered as a means, should be parsimonious in its support of FPs.

Must have vs nice to have. The evaluation criteria can be sorted, according to the strength of their expectation: based on their definition, three of the criteria can be described as “must have:” support, compatibility and feasibility; three can be described as “should have:” coverage, sufficiency and parsimony; and one criterion can be described as “nice to have:” synergy. A graphical representation of the first six evaluation criteria is presented below.

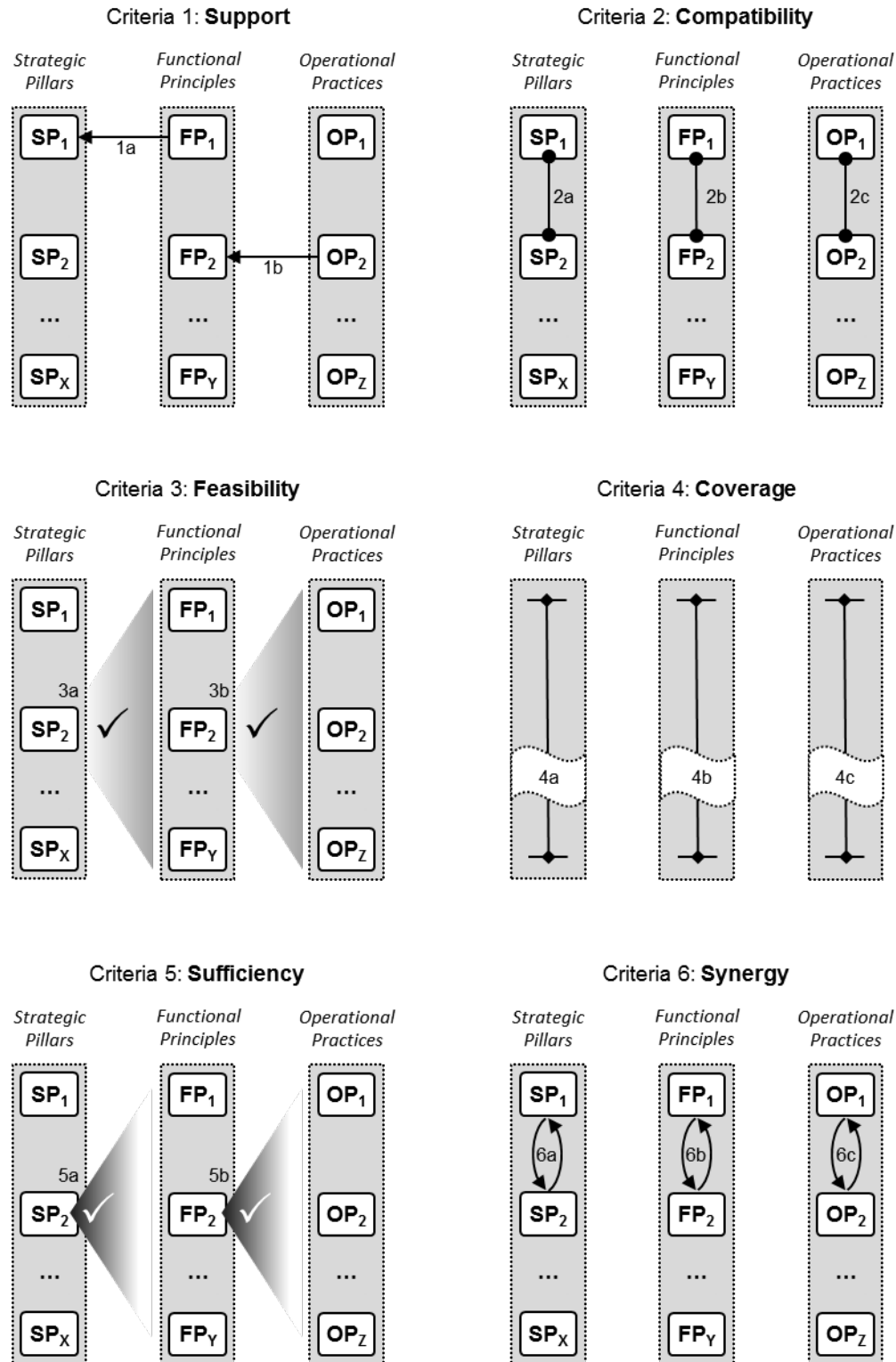


Figure 2: Graphical representation of the first six evaluation criteria

Similar yet different. The evaluation criteria address different relationships along similar

lines. In order to avoid confusion, let us clarify the difference between criteria that may at first deal with the same relationship.

- *Compatibility and synergy* are different in that *compatibility* only requires that two concepts be able to coexist, whereas *synergy* requires that these two concepts mutually reinforce each other. Synergy presupposes compatibility, but compatibility does not ensure synergy.
- *Support and sufficiency* are different in that *support* only requires that a given concept work in favor of a concept in a higher level, whereas *sufficiency* entails that a concept is satisfied to the largest extent possible by the combined efforts of all concepts under it. Thus, although sufficiency requires support, support does not guarantee sufficiency.
- *Feasibility and sufficiency* are different since feasibility only requires that a given concept can – *in theory* – be “carried out” by concepts under it, whereas sufficiency entails that a concept has – *in practice* – been “carried out” by the concepts under it to the point that it is satisfied to the largest extent possible.

Evaluation Mechanisms

Evaluation criteria are useful to the extent they can be actually applied, and this application requires a mechanism. In this section we present some mechanisms we propose to apply the evaluation criteria we have presented above. The mechanisms proposed here are works in progress, and they will likely be improved through additional work and future projects.

For support, compatibility and synergy

The evaluation mechanisms for support, compatibility and synergy are largely similar, in that they make use of evaluation matrices, provide a structured approach and rely heavily on a group of experts. Since the logic behind these three evaluation mechanisms are similar, we explain one in detail and then indicate the differences that apply to the other two.

Support is evaluated by asking the group of experts to assess the support that a concept provides to another concept above it. In the case of *functional support*, it would be the support that each FP provides to each SP. The assessment of *functional support* is done in two rounds. An empty template matrix, of a size $N_{FP} \times N_{SP}$, is built, where N_{FP} is the number of FPs and N_{SP} is the number of SPs. FPs are used as column headings, and SPs are used as row headings.

For each cell in the matrix we prepare a question about the support that the FP heading the cell's column provides to the SP heading the cell's row. The wording for the question for cell (i,j) reads, for example, “[Functional Principle i] helps our goal of [Strategic Pillar j]”. In a first round, each expert is asked to answer these questions on their own, in terms of answer choices in the form of a Likert scale (Brill, 2008), such as the following:

1. *It provides crucial support to the goal*
2. *It provides significant support to the goal*
3. *It provides only a little support to the goal*
4. *It makes no difference for this goal*
5. *It detracts only a little from the goal*
6. *It significantly detracts from the goal*
7. *It completely detracts from the goal*
8. *I am not sure*

The answers provided by individual respondents to these questions are coded in order to be analyzed. An approach that has proven useful is to calculate the percentage of the respondents who described the relationship as '*Supportive*' (options 1 and 2), as '*Detrimental*' (options 6 and 7), as '*Mostly neutral*' (options 3 through 5) and as '*Unsure*' (option 8).

These four percentages are arranged in four separate matrices. Each value is put in the cell that corresponds to the question for which it was calculated. To facilitate reading the matrices, one may highlight cells that contain values above a certain threshold. No threshold value applies to all instances, so the recommendation is to try out different thresholds values. In previous projects we have used 50%, 33% and 25% as thresholds, to highlight values that indicate when at least half, a third or a quarter of respondents, respectively, answered in a given way. There are several ways to derive insights from the matrices thus prepared. Sometimes simple inspection will reveal an interesting pattern, whereas in other instances it is useful to express, both verbally and graphically, the relationships that correspond to the highlighted values in each matrix. Verbally, each relationship can be expressed using a statement of the form: "*X% of respondents expressed that Y supports Z;*" "*X% of respondents expressed Y is detrimental for Z;*" etc. Graphically, several relationships can be expressed using a conceptual diagram, where concepts are depicted as boxes, with lines connecting them to illustrate relationships of incompatibility, support, detriment, etc. Examples of this are provided in Section 5.

Operational support can be evaluated following an identical mechanism, but using OPs instead of FPs as the concepts providing support, and FPs instead of STs as the concepts

receiving the support.

Compatibility, within any of the three layers, can be evaluated following a similar mechanism, with just a few differences. The first difference is that the empty template matrix will use the same concepts as column headings and as row headings. More than half of its cells need not be explored because: (a) cells along the long diagonal need not be evaluated, and (b) for the rest, it is enough to evaluate the cells at one side of the long diagonal, since compatibility is a reciprocal relationship. The second difference is that the wording for the questions will read “is compatible with” instead of “helps our goal of”. A third difference is that the answer choices are different, e.g. as follows:

1. *Yes, they are totally compatible*
2. *They are somewhat compatible*
3. *They are somewhat incompatible*
4. *No, they are totally incompatible*
5. *I am not sure*

The answers can then be coded so as to calculate the percentage of the respondents who described the relationship as '*Compatible*' (options 1 and 2), as '*Incompatible*' (options 3 and 4), and as '*Unsure*' (option 5). When expressing the relationships verbally, the statements are worded in the form "*X% of respondents expressed there is an incompatibility between Y and Z.*"

Synergy, within any of the three layers, can be evaluated using a similar mechanism. A first difference is that the template matrix will use the same concepts as column headings and as row headings; and cells along the long diagonal need not be evaluated. However, since *synergy* requires a reciprocal exchange of support, cells at both sides of the long diagonal need to be evaluated. A second difference is that the wording for the questions is slightly different: for cell (i,j) the question could reads, for example, “[Concept i] helps us [Concept j]”. Answer choices could be in the following form:

1. *It provides crucial support*
2. *It provides significant support*
3. *It may provide a little bit of support*
4. *It makes no difference*
5. *It is detrimental, but only a little*
6. *It is significantly detrimental*
7. *It is absolutely detrimental*
8. *I am not sure*

Answers are coded as follows: option 1 is coded as +3, option 2 is coded as +2, option 3 is coded as +1, option 4 is coded as 0, option 5 is coded as -1, option 6 is coded as -2, option 7 is

coded as -3, and option 8 is coded as either 0 or left empty. The averages of the coded answers are arranged in the template matrix and then, when reading the matrices for signs of *synergy*, one looks for symmetrical values, e.g. values that occur in pairs, at opposite sides of the long diagonal, over a certain threshold value, both positive and negative. An example is provided in Section 5.

For coverage, sufficiency, feasibility and parsimony

The mechanisms for the evaluation of *coverage*, *sufficiency* and *feasibility*, although equally reliant on a group of experts, are different from the mechanisms presented above, in that they are somewhat less structured and make no use of evaluation matrices.

Coverage is evaluated by asking the individual experts, separately, what areas of interest are not currently being addressed by the supply chain strategy. The answers of individuals are then discussed and expanded in a panel. This can be done for all three levels in the FSM. The explicit nature of the FSM facilitates the identification of the areas of interest that *are* being addressed by the supply chain strategy, thus making it relatively easy for a group of experts to identify the areas of interest that *are not* being addressed (e.g. that are absent from the FSM). In our projects so far there has not been a need for a mechanism more refined than this. A provision we have found useful is taking extensive notes, while the FSM is being built, of all comments regarding: (a) things the business unit could be doing but is not, and (b) areas that seem relevant, for which the business unit has no clear established policy. These comments are typically indicative of shortcomings in coverage.

Sufficiency is evaluated by asking the individuals what objectives are not currently being satisfied by the supply chain strategy. For functional sufficiency, the question revolves around whether functional objectives, as stated in the FPs, are being satisfied. For strategic sufficiency, the question is whether strategic objectives, as stated in the SPs, are being satisfied. Answers typically have the form of comments on grievances or shortcomings, ways in which the supply chain is falling short of the expectations. It is also possible to use a series of answer choices. To the question “To what extent is X being satisfied as an objective?”, the respondents can be asked to select from:

1. *Yes, it is fully satisfied*
2. *Yes, it is mostly satisfied*
3. *It is partly satisfied*

4. *No, it is mostly unsatisfied*
5. *No, it is fully unsatisfied*
6. *I am not sure*

The individual answers are aggregated and presented to the expert group, for discussion and expansion. Like in the case of coverage, such a simple mechanism has sufficed so far in our projects, without need for more structure. However, we anticipate that *sufficiency* is a criterion where a more elaborate mechanism may be desirable: for example, KPIs, both strategic and functional, could play a role in the evaluation of sufficiency.

Feasibility is evaluated by asking the individuals whether a concept can be “carried out.” This criterion may be more relevant when evaluating an alternative or a new supply chain strategy than when evaluating an existing supply chain strategy. For *strategic feasibility*, the question revolves around whether strategic pillars can be fully translated into a set of specific functional ideas, in the form of FPs. For *functional feasibility*, the question is whether functional principles can be fully deployed by means of operational ideas, in the form of OPs.

Parsimony is evaluated by asking the individuals, given each concept that is used as a means, whether it would be possible to provide a similar level of support while making better use of resources, e.g. if a more economical means could achieve the same ends. For *functional parsimony*, the question revolves around whether functional principles are making the best use of resources in supporting the strategic pillars, e.g. whether the same level of functional support could be provided to the SP by more economical means. For *operational parsimony*, the question is whether operational practices are making the best use of resources in support of the functional principles, e.g. whether the same level of operational support could be provided to the FP by more economical means.

4. DEVELOPING THE FSE FRAMEWORK

In the previous section we described the Functional Strategy Evaluation Framework, as it has been formalized after projects and comparison to extant literature. In this section we describe the process that we followed to develop it: namely, how – from the starting point of using a supply chain strategy characterized as an FSM – we moved into selecting a set of evaluation criteria and mechanisms. The evolution of the evaluation criteria, to be described below, is graphically represented in Figure 3.

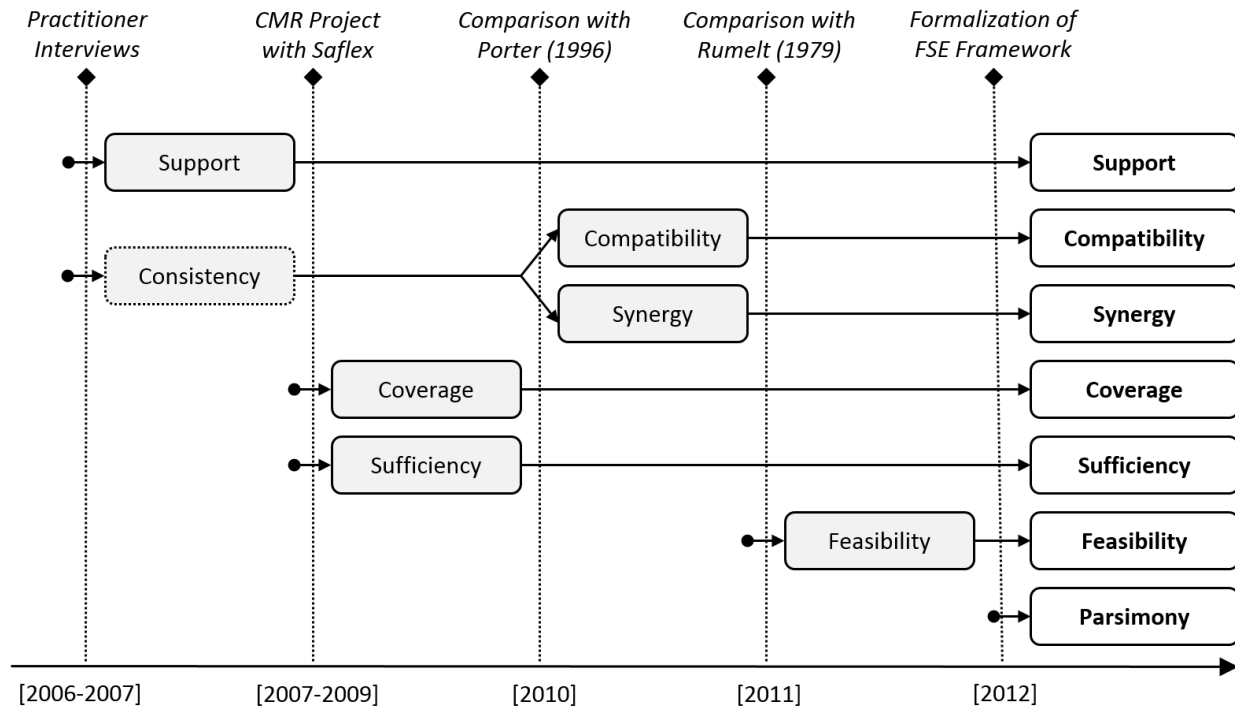


Figure 3: Evolution of the FSE criteria

Initial criteria. An initial set of two criteria to evaluate a supply chain strategy, using its FSM as a starting point, was suggested by insights from interviews with supply chain practitioners. In 2007 we conducted a set of 46 qualitative interviews on the subject of strategic supply chain management: five on an exploratory basis, and the rest as part of a first collaborative management research (CMR) project. Two relevant insights derived from these interviews were that practitioners expected the supply chain strategy of a business unit to: (a) provide *support* to the business strategy of this business unit, and (b) to display a *consistency* (or harmony) both internally and with other related functional strategies. This suggested as two early evaluation criteria the following: *support* of the functional principles to the strategic pillars, and *consistency* among the functional principles.

Initial mechanism. As an evaluation mechanism for the criterion of *support*, a tool known as ‘evaluation matrix,’ with a long tradition in the conceptual design of products as diverse as vehicles and software, caught our attention as a good candidate. Evaluation matrices are found at the core of Pugh Controlled Convergence, (PuCC), a method developed by Stuart Pugh and refined over a decade of field work with industry, to narrow down choices in the early stages of a conceptual design (Pugh, 1990; Frey *et al.*, 2007). As used in PuCC, the ‘evaluation matrix’ has:

(a) as vertical headers a list of expectations that will be used to judge the merits of a given design concept, (b) as horizontal headers a series of design concepts to be evaluated, and (c) on each cell of the matrix an assessment of the ability of a given design concept to satisfy a given expectation, as compared to a reference concept or *datum*. We adapted Pugh's evaluation matrix to serve as a mechanism to evaluate support. A first matrix could be built as follows: (a) as vertical headers, use the strategic themes from the FSM, (b) as horizontal headers, use the functional themes from the FSM, and (c) in each cell of the matrix, an assessment of *functional support* provided – in the Pugh tradition – by a team of experts, with the difference that there is no reference concept or *datum*. Similarly, a second matrix could be built where we use: (a) as vertical headers, the functional themes from the FSM, (b) as horizontal headers, the operational themes from the FSM, and (c) in each cell of the matrix, an assessment of *operational support* provided by a team of experts.

A different type of matrix, widely used for analyzing engineering systems, suggested a mechanism for evaluation along the criterion of *consistency*. Known as Design Structure Matrix, or DSM (Eppinger, Whitney, Smith, & Gebala, 1994), this tool consists of a matrix representation of dependencies within a system. It uses the same list of components of the system for both the vertical headers and the horizontal headers. The cells in the matrix indicate whether one component of the system depends on another. The DSM is often used for system analysis, and has been adapted to socio-technical systems, including supply chains (Bartolomei, 2007.) It is possible to adapt the DSM matrix for our evaluation purposes, by using the functional themes from the FSM as both horizontal and vertical headers in a matrix, and inserting in each cell of the matrix an assessment of *inter-functional support* provided by a team of experts.

Testing and revising the framework. These initial evaluation criteria and methods were tested in a *desk trial* using data from a secondary case study. Encouraged by their potential, a series of steps was devised for building the empty matrices, collecting the data that would go into them, and analyzing them for insights. These steps – the embryo of our evaluation framework – were tested, improved and refined through two in-depth collaborative management research projects. Collaborative management research (CMR) is “defined as *an emergent and systematic inquiry process*, embedded in an agreed-upon *partnership* between actors with an interest in influencing a certain system of action and researchers interested in understanding and explaining such systems” (Pasmore, Stymne, Shani, Mohrman and Adler, 2008; emphasis in the original).

The origins of collaborative management research, according to Shani, David and Willson (2004), can be traced back to the works of *action research* pioneers. Action research, defined by Harris (2007) as “an informed investigation into a real management issue ... resulting in an actionable solution” is – according to Naslund (2002) – “especially suited for an applied field such as logistics” since it strives “to advance both science and practice.”

First case study. The first CMR project was conducted with Saflex, a business unit of Solutia, a specialty chemical manufacturer. Evaluation of their supply chain strategy was only the second of three parts to this project, the other two being capture and reformulation. Although the whole project lasted two years, the evaluation phase lasted only two months. As part of the evaluation phase, a panel of managers from the supply chain function of the firm was convened for half a day to discuss the insights derived from the evaluation matrices. Their comments during this session reinforced the validity of *support* and *consistency* as useful evaluation criteria, but also suggested that other criteria may be needed. Participants remarked that, through examination of the FSM, that the supply chain strategy was not properly addressing several areas of interest for them, namely innovation, collaboration and organizational structure. These gaps were described as ‘shortcomings in coverage,’ and suggested a third evaluation criterion: *coverage*. Additionally, the point was made by a participant that it was necessary to consider whether the support received by a strategic pillar was enough to satisfy it as a goal. For example, a strategic pillar may be receiving support from a several functional principles, and yet not be fully satisfied as a goal. This idea resonated with the team, which suggested a fourth evaluation criterion: *sufficiency*. We revised the emergent evaluation framework accordingly.

Second case study. A second CMR project was conducted with Libica⁷, a health-care company with approximately \$100B in annual sales. The project – which spanned over seven months, with one and a half dedicated to evaluation – allowed us to test the revised evaluation framework. *Coverage* was quickly accepted by the team as an evaluation criterion. The straightforward mechanism used to evaluate coverage, namely a discussion, of what areas of interest – if any – are absent from the FSM, was effective in revealing multiple shortcomings in coverage. The idea of *sufficiency* as an evaluation criterion was also quickly embraced by the

⁷ The name of this company and other sensitive information has been disguised.

team. The mechanism used to identify shortcomings in sufficiency also kept simple: during the data collection for building the FSM and the sessions to validate it, notes were made of all comments about areas in which the performance of the supply chain is falling short of expectations. The evaluation framework was again revised accordingly to these findings, and formalized into a documented protocol with enough detail to be actionable.

A separate case study conducted as a Master thesis by (citation to be added after double blind peer review), applied the revised evaluation method to the evaluation of the supply chain strategy of a specific project of a company in the aerospace industry. An innovation in this thesis is that *support* was evaluated by directly asking a group of experts their opinion regarding whether – and to what extent – each strategic goal was being satisfied. This approach has been incorporated into the revised protocol of the evaluation framework.

Back to the literature. Having tested and revised the evaluation framework in two cases directly, and in a third case through a third party, we proceeded to compare the results, particularly the evaluation criteria and mechanisms, with the existing literature. Comparing emergent theoretical results with the existing literature is a recommended practice in the development of theory from case studies (Eisenhardt, 1989; Ellram, 1996). Although we did not find in the literature anything in terms of explicit mechanisms for the evaluation of strategy, we did find two sets of evaluation criteria in the strategic management literature. These served to validate and enrich our own set of criteria, as described below.

Porter's criteria. The first set of criteria was found in Porter (1996), where three types of “strategic fit” are proposed: *first order fit*, when activities display a simple consistency with the overall strategy and with other “activities (functions)”; *second order fit*, when activities reinforce each other; and *third order fit*, which – in Porter’s words – refer to an ‘optimization of effort.’ Porter’s ideas of activity-system maps and fitness have been applied to supply chains (i.e. Ayers, 2006; Ayers, 2012). Porter argues that an activity-system map “can be useful for examining and strengthening strategic fit,” and – since the FSM can be described as an expansion of the ‘activity-system map’ (Porter, 1996) to multiple layers in order to address the problem of supply chain strategy – his ideas about fitness may be applicable to supply chain strategy evaluation. The idea of *first order fit* seemed to map directly with two of our evaluation criteria: in the first sense, as simple consistency with the overall strategy, it corresponds to our criterion of *support*,

whereas in its second sense, as simple consistency of activities in the functions, it corresponds to our criterion of *consistency*. Interestingly, the idea of *second order fit* as reinforcing consistency between activities *also* mapped to our criterion of *consistency*. This suggested our criterion of consistency was confounding two related yet distinct relationships: simple consistency and reinforcing consistency. This realization led us to replace our criterion of *consistency* with two new evaluation criteria: *compatibility* (equivalent to Porter's *first order fit* as simple consistency of activities) and *synergy* (equivalent to Porter's second order fit as reinforcing consistency of activities). Since we found in our CMR projects empirical data to support these two new criteria (as will be shown in the next section), they were added to our criteria set. Porter's *third order fit*, with no equivalent in our evaluation criteria, suggests an additional criterion that we would call *optimality* and which would seek to answer the question: "Is this strategy, as a whole, the best we can do to translate our efforts into results?" However, since we did not find in our empirical data from the CMR projects any support for such a criterion, we have not added it to our evaluation criteria set.

Rumelt's criteria. Further validation and enrichment to our revised criteria came from comparing it with a second set, found in Rumelt (1979). Rumelt's four "strategy evaluation criteria" include: the *goal consistency test*, which states that "a strategy that contains goals, objectives, and policies that are mutually inconsistent must be rejected;" the *frame test*, which states that a "principal function of strategy" is to "separate the important from the unimportant and to define the critical subproblems to be dealt with;" the *competence test*, which states that a strategy should "structure a situation in a way that creates solvable subproblems", which "can be dealt with by existing and demonstrated ... skills, resources and competences" (implying that "strategies that do not result in solvable subproblems must be rejected"); and the *workability test*, which asks "Will it work? Will the proposed policies and actions work together to produce the results sought?" Comparing the ideas behind Rumelt's four evaluation criteria and our revised set, we concluded that his *goal consistency test* corresponds to our criterion of *compatibility*, that his *frame test* corresponds to our criterion of *coverage*, and that his *workability test* corresponds to our criterion of *sufficiency*. Interestingly, his *competence test* had no equivalent on our set. Based on this insight, we considered a new evaluation criterion: *feasibility*. Since we found in our CMR projects empirical data to support this new criterion (as will be shown in the next section) it was added to our set.

A listing our revised evaluation criteria, along with the corresponding criteria from Porter (1996) and Rumelt (1979), is presented in Table 3.

FSE Criteria	Theoretical precedent	Empirical support
Support	Porter's (1996) <i>first-order fit</i> (simple consistency with overall strategy.)	CMP Project 1, CMP Project 2, Masters Project
Compatibility	Both Rumelt's (1979) <i>consistency test</i> and Porter's (1996) <i>first-order fit</i> (e.g. simple consistency between functions.)	CMP Project 2, Masters Project
Feasibility	Rumelt's (1979) <i>competence test</i> .	CMP Project 2 (retrospective)
Coverage	Rumelt's (1979) <i>frame test</i> .	CMP Project 1, CMP Project 2,
Sufficiency	Rumelt's (1979) <i>workability test</i> .	CMP Project 1, CMP Project 2, Masters Project
Synergy	Porter's (1996) <i>second-order fit</i> .	CMP Project 1, Masters Project

Table 3: Comparison of evaluation criteria from the FSE Framework and other sources

The seventh general evaluation criteria, Parsimony, meaning economy in the use of resources while achieving equal results, was conceived during the process of formalizing the framework.

5. ILLUSTRATING THE FSE FRAMEWORK

This section illustrates the FSE Framework with examples taken from our case studies with Saflex and Libica. Information has been disguised where appropriate. In both the case of Saflex and Libica, questionnaires for the matrix-based mechanisms were administered online and the progress of responses was monitored. A week after the questionnaires were delivered, reminders were sent to individuals that had not replied. Response rates were 86% for Saflex and 95% for Libica. A key to obtaining such high response rates may have been the strong commitment from the respective project sponsors.

Example of Characterization. Figure 4 provides an example of the characterization of a given supply chain strategy by means of a Functional Strategy Map (FSM), showing only the three middle levels that are used for evaluation. This particular FSM describes the supply chain strategy of Saflex, a business unit of a Fortune 100 chemical company, with operations in the Europe, Asia and the Americas, which was the subject of our first CMR project.

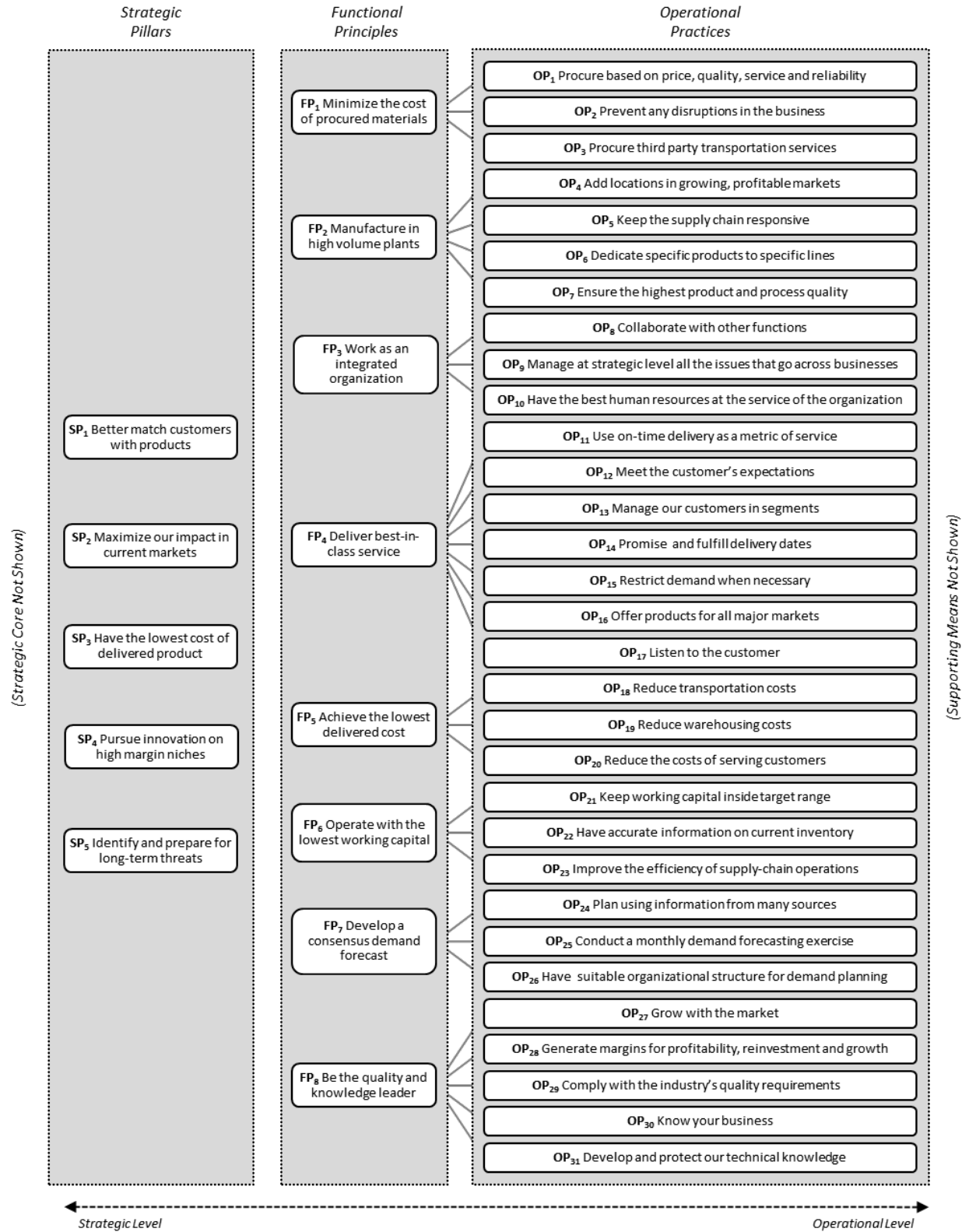


Figure 4: Three layer FSM for the supply chain strategy of Saflex (2008)

The examples shown below come from many projects, not only this one, and therefore not all the examples below can be traced back to this FSM.

Example of Support Evaluation. Below is an example of evaluation of *functional support* taken from our project with Saflex. In their FSM (Figure 4), the fourth strategic pillar (SP₄) reads: “*Pursue innovation on high margin niches.*” The third functional principle (FP₃) reads: “*Work as an integrated organization.*” Saflex’s group of expert was presented a question about the support FT₃ provides to ST₅: “*Does working as an integrated organization help us to pursue innovation on high margin niches?*” Their answers, to this and all other questions for this criterion, were coded and arranged in matrices. Figure 5 presents the matrix showing the ‘Supportive’ values, using 50% as threshold value for cell highlighting. Inspection of this matrix suggests that FP₃ is largely supportive of all SPs.

	FP1	FP2	FP3	FP4	FP5	FP6	FP7	FP8
SP1	50%	10%	70%	70%	60%	10%	50%	60%
SP2	60%	50%	60%	20%	90%	20%	40%	50%
SP3	90%	70%	80%	10%	89%	40%	70%	0%
SP4	10%	0%	50%	10%	20%	0%	10%	30%
SP5	40%	20%	60%	50%	50%	20%	30%	40%

Figure 5: Saflex's functional support matrix showing ‘Supportive’ values

Figure 6 presents the matrix with ‘Detrimental’ values, using the same threshold value. Inspection of this matrix suggests that FP₆ is largely detrimental to all SPs, and that all FPs are detrimental to SP₄.

	FP1	FP2	FP3	FP4	FP5	FP6	FP7	FP8
SP1	50%	60%	20%	30%	40%	80%	50%	40%
SP2	40%	40%	30%	70%	10%	70%	60%	50%
SP3	10%	10%	20%	30%	0%	60%	30%	70%
SP4	70%	60%	50%	80%	60%	80%	90%	70%
SP5	60%	50%	30%	50%	40%	50%	60%	50%

Figure 6: Saflex's functional support matrix showing ‘Detrimental’ values

Example of Compatibility Evaluation. Below is an example of evaluation of functional compatibility taken from our project with Libica. Their FSM is not shown in this paper. Figure 7 shows the matrix with the ‘Incompatible’ values, where the threshold value for highlights was set

at 33%. The five highlighted cells indicate five incompatibility relationships.

Expressing verbally and graphically the most outstanding relationships found in the matrices helps us derive finer-grained insights. We can express each incompatibility relationship verbally.

	Focus our efforts in efficient distribution	Move towards value-added services	Deliver fast, accurately, safely and reliably	Operate using lean principles	Improve profitability through customer and product mix	Address the direct-to-store and bulk needs of national accounts	Address the delivery and other special needs of workshop customers	Help independent retailers be more competitive	Simplify things for us in our interaction with the customer	Collaborate with our suppliers, but not in all relevant areas	Manage through clear and well communicated objectives	Improve the impact of our workforce
Focus our efforts in efficient distribution												
Move towards value-added services	0%											
Deliver fast, accurately, safely and reliably	0%	27%										
Operate using lean principles	0%	0%	0%									
Improve profitability through customer and product mix	27%	18%	18%	9%								
Address the direct-to-store and bulk needs of national accounts	0%	0%	0%	0%	9%							
Address the delivery and other special needs of workshop customers	9%	0%	9%	0%	15%	38%						
Help independent retailers be more competitive	0%	0%	0%	0%	9%	73%	38%					
Simplify things for us in our interaction with the customer	0%	0%	0%	0%	23%	9%	0%	18%				
Collaborate with our suppliers, but not in all relevant areas	0%	0%	0%	0%	10%	18%	0%	0%	18%			
Manage through clear and well communicated objectives	0%	0%	0%	0%	0%	0%	0%	18%	0%	8%		
Improve the impact of our workforce	8%	0%	0%	0%	9%	0%	0%	15%	0%	9%	0%	

Figure 7: Libica's functional compatibility matrix showing 'Incompatible' values

For example, the matrix suggests that “Addressing the direct-to-store and bulk needs of national accounts is at least partly incompatible with helping independent retailers be more competitive.” We can also express the incompatibilities *graphically*. For example, all five incompatibilities found in the matrix above can be expressed graphically, as shown in Figure 8. A conceptual map communicates all five incompatibilities in a clean and concise manner.

Examples of Synergy Evaluation. Below is an example of evaluation of functional synergy, built with data from our project with Saflex. Figure 9 shows four matrices. The one labeled ‘A’

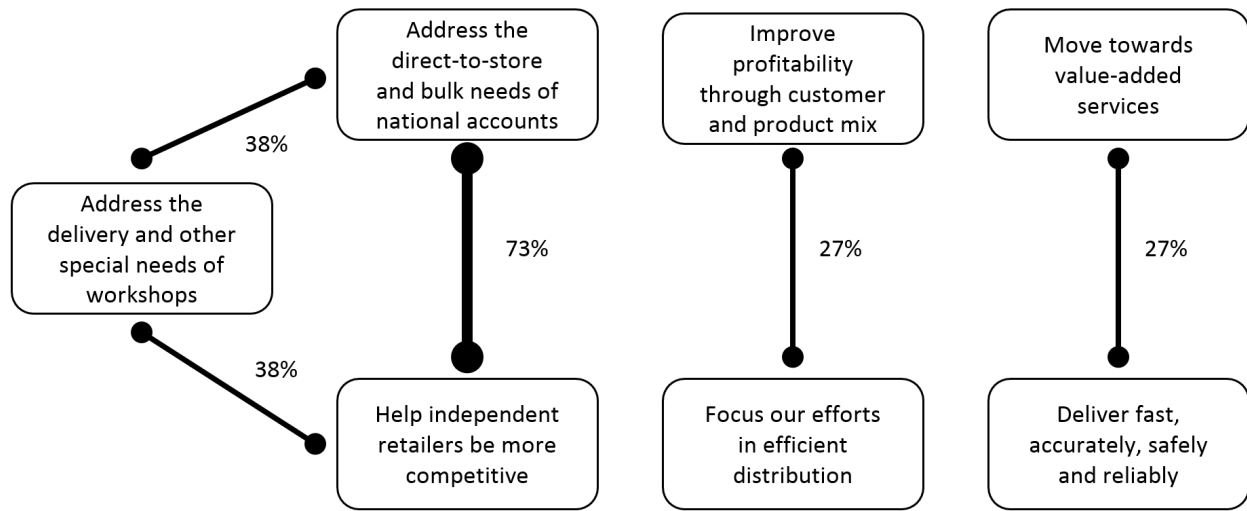


Figure 8: Graphical representation of the incompatibilities among Libica's FPs

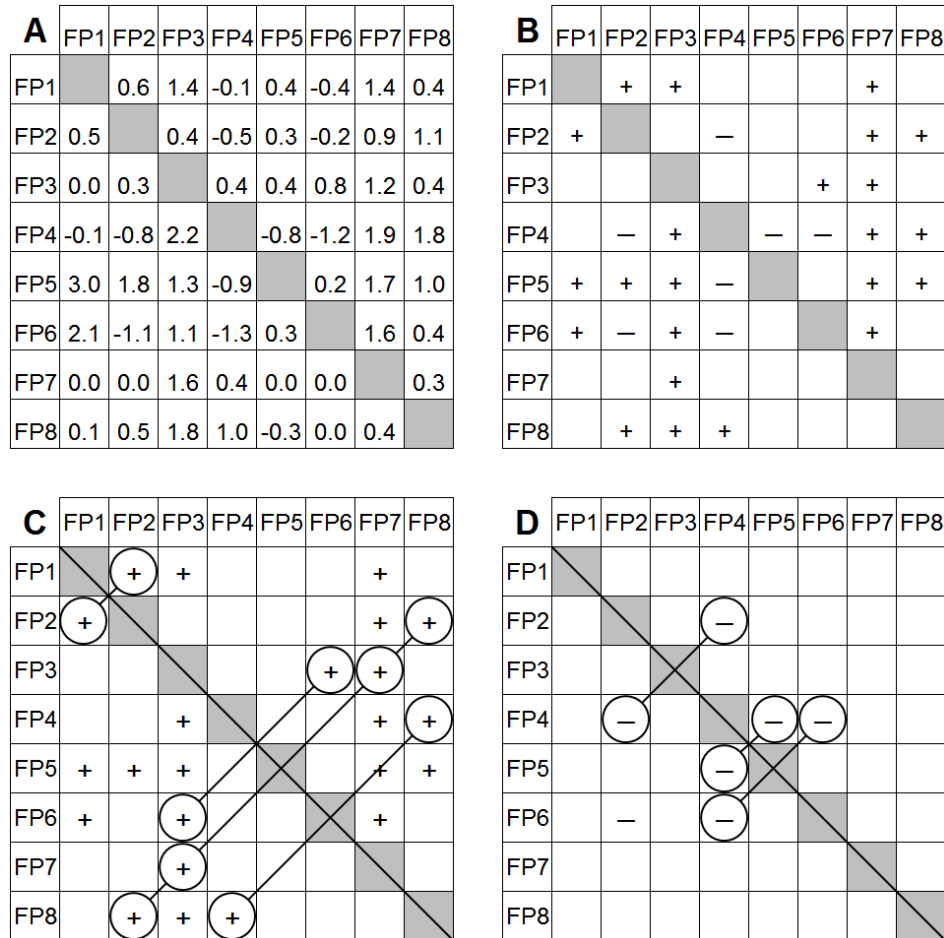


Figure 9: Saflex's functional synergy matrices

shows the average of the coded answers from the questionnaire administered to Saflex experts. In the matrix labeled ‘B’ we replaced the positive values over 0.5 (about 3 in 5 positive values) with a “+” sign, and the negative values under -0.5 (about 3 in 5 negative values) with a “-” sign.

The matrix labeled ‘C’ in Figure 9 shows ‘functional synergy’, e.g. reciprocally supportive relationships between FPs. These synergetic relationships can be represented graphically, as shown in Figure 10.

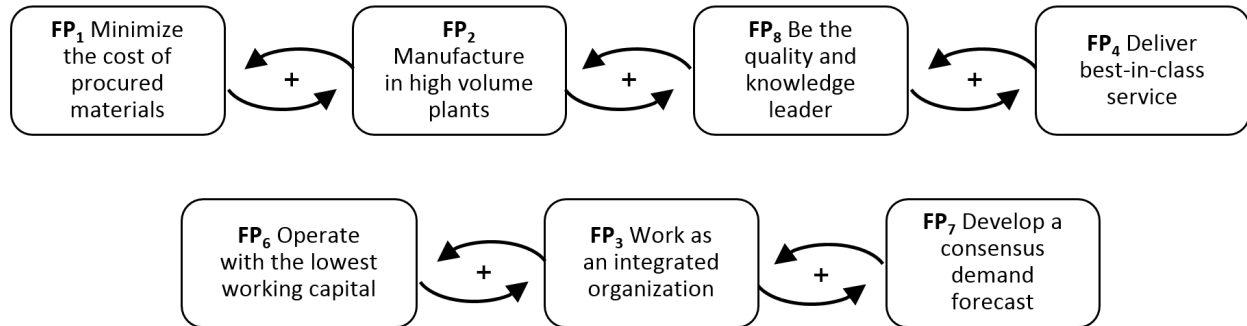


Figure 10: Graphical representation of Saflex’s functional synergies

Finally, the matrix labeled ‘D’ shows what we would call ‘functional anti-synergy’, e.g. reciprocally detrimental relationships between FPs, which is often a sign of a trade-off. Anti-synergetic relationships can be represented graphically, as shown in Figure 11.

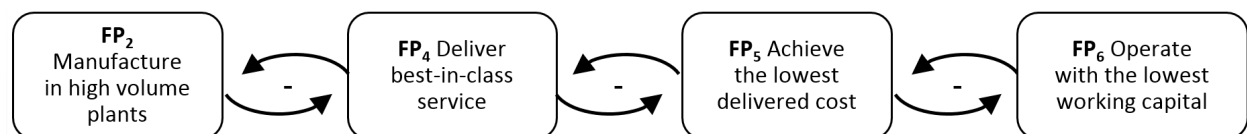


Figure 11: Graphical representation of Saflex’s functional anti-synergies

Examples of Coverage Evaluation. Commenting on Libica’s FSM, three different experts pointed out separately to the absence of collaboration with customers, particularly large national accounts. Thus, “Collaboration with customers” was noted as a coverage shortcoming. Another example of coverage evaluation, this time from Saflex: in a session to discuss the findings of the alignment evaluation, several experts commented that the supply chain would be better off if they could collaborate with suppliers and customers. Given these comments and noticing their FSM had no reference to collaboration, “Collaboration with other supply chain parties” was noted as a coverage shortcoming.

Examples of Sufficiency Evaluation. During an interview, we asked one of Libica's experts what he wished his company had done differently in the past to prevent a certain type of problems he had just described. He said: "I wish that Libica was a more customer-focused organization, from the beginning." Asked to clarify what he meant by "more customer-focused," he replied: "Where we are now is that we have resources that face towards our manufacturers ... and then when you look on the customer side, due to the nature of the business ... I think we've lost the ability to really understand how our customers make money and how we help them make money." This argument suggests that some of Libica's strategic objectives, namely to "Make our customer's business less complex and more cost effective" and to "Deliver exceptional customer service" are not being fully satisfied.

Examples of Feasibility Evaluation. The following are two examples of *feasibility* evaluation, taken from a reformulation exercise with Libica. An example of *strategic feasibility*: according to their team of experts, a new strategic pillar: "Change the game: move away from price, and into value and solutions", can be carried out by means of the following functional principles: (a) work with customers to improve and manage their supply chain, (b) master the art of minimizing and dealing with complexity, e.g. learn how to exploit latent capabilities to work with complexity, and (c) develop a real time understand of what is going on in the business. An example of *functional feasibility*: according to their team of experts, a new functional principle: "Learn how to use metrics wisely", can be carried out by means of the following operational practices: (a) align the metrics used around the organization with each other and with the overall objectives, (b) use a more scientific, systems-wide way to set the metrics, (c) develop an understanding of the impact of each metric, how getting them right or wrong affects us, (d) avoid metrics for the sake of metrics, and know when a metric is good enough so that we can move on, and (e) make sure all parts that impact the supply chain are using the right metrics for their parts of the organization and that they be held accountable to the metrics.

There are no examples of Parsimony evaluation, since this criteria was identified after the two CMR projects had already been completed.

6. DISCUSSION

The approach we propose gives members of the business unit an opportunity to evaluate their supply chain strategy in their own terms, according to their own understanding and knowledge of

their business. It seeks to take full advantage of the *internal wisdom* of the organization, while minimizing the reliance on *external wisdom* taken from the literature. It is, borrowing the concept from anthropology, more of an '*emic*' approach, in that it keeps things in the same terms used by the organization. It avoids bringing into the process any '*etic*', foreign concepts.

The approach we propose relies heavily on the members of the organization to conduct tasks that may be—in the words of a participant — "*tedious*": there is a feeling of repetition in answering the questionnaires, and the respondents may feel that the process is burdensome. However, this reliance on the team members, which is most likely the most significant downside of the method, happens to be its biggest strength. By following this '*true to self*' approach, we allow the group the opportunity to evaluate their supply chain strategy in their own terms and words, according to their own understanding and based on their own knowledge of their business.

Saflex's VP of Supply Chain told us, before conducting the exercise with us, that he had been looking in the literature for a "roadmap to do" supply chain strategy, but found none. "There are many books about strategy," he said, "but they are basically theory," as opposed to a real-world, actionable "process that we can walk." After our exercise with our method, he commented on the evaluation exercise: "Your system seems to be able to single out and capture the fundamental issues we're struggling with." He added: "I think we have a foundation for moving forward."

Since the impact of supply chain strategy are felt over many years, during which a multitude of other factors affect the performance of the business unit, it is difficult to verify experimentally the efficacy of this or any other strategy evaluation and setting method. Instead, we rely on the organization itself, on the feedback from the executives heading the supply chain in the companies we worked with. We submit that evidence in support of our method is found in comments made by the project sponsors.

During the session with Saflex to validate the evaluation findings, the VP of Supply Chain said of these following: "You've hit the nail in the head." He added: "This is a very good crystallization of things." On the evaluation report, he said: "The report highlights the key issues. ... You managed to find the key conflicts." Commenting on a 3-way conflict we had found in Saflex's current supply chain strategy, he commented: "The 3-way conflict is a very, very important item right now."

Likewise in the Libica, VP of Operations and Supply Chain commented during our final meeting that his reaction to being faced with the 3-way conflict shown on the left hand side of Figure 8 was like an epiphany: “To me, it was like a light bulb went off...,” he said, adding that he realized then that: “We are trying to do everything!... And that was clear from the material.” Here, ‘the material’ refers to the evaluation matrices and the graphs he was shown during the validation session.

The portability of the approach was tested by conducting workshops with graduate students. A guide was provided to graduate students in a masters-level supply chain strategy class in the United States, where 25 students applied the evaluation method to data collected from the Saflex exercise, as part of a project. A second group of 12 students, as part of a supply chain strategy seminar in Latin America, were asked to apply the evaluation method to a case study chosen by them. These students built an evaluation matrix on their own, collected data to complete it and analyzed it to derived insights. They also identified shortcomings in coverage and sufficiency. These results suggest the method is portable.

7. CONCLUSION

In this paper we have presented a type-independent approach to evaluate a business unit's supply chain strategy as a conceptual system. The approach uses as its starting point a conceptualization of the supply chain strategy known as a functional strategy map, or FSM. It seeks to free the business unit from reliance on artificial types of supply chain strategy and other *external wisdom*, that is to say, knowledge derived from other settings that may or may not apply to the business unit's circumstances. Instead, it seeks to provide a simple and intuitively appealing framework for the business unit to conduct an evaluation of their supply chain strategy based on the *internal* wisdom of those most familiar with the target supply chain.

The approach we have proposed calls for evaluating the supply chain strategy of a business unit along seven general criteria: *Support*, the expectation that supply chain activities provide support to supply chain objectives; *Compatibility*, the expectation that elements of the supply chain strategy be compatible with each other; *Feasibility*, the expectation that supply chain objectives are such that they can be carried out in reality; *Coverage*, the recommendation that all areas of interest to the supply chain be properly addressed in the strategy; *Sufficiency*, the expectation that supply chain objectives are satisfied by the combined effort of supply chain

activities; *Parsimony*, the expectation that supply chain activities be economical in their use of resources; and *Synergy*, the hope that elements of the supply chain strategy mutually reinforce other elements. For each one of these evaluation criteria, we have proposed an evaluation method.

Both the proposed criteria and method were tested and refined through two action research projects. The ability of the approach to identify conflicts in the supply chain strategy provides evidence in support of its evaluative power. It revealed trouble areas that were recognized by the business unit as verisimilar and relevant, and yet in some cases they were unexpected. The transferability of the method and the criteria was tested by asking students to apply it using documentation as a guide, with satisfactory results. Our deployments of the method in two projects confirmed that insights generated during the evaluation address both internal aspects and external aspects involving trading partners. As more replications are conducted, our understanding of the capabilities and limitations of both the criteria and the method are bound to improve. At this point, nevertheless, the method and criteria have shown enough promise to warrant further exploration and refinement, and represent a novel contribution to the literature.

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